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PHASE I

Geology, Energy, and Mineral (GEM)
Resource Assessment of the Bloomington
GRA, Idaho, including the Worm Creek
(37-77) Wilderness Study Area

Bureau of Land Management
Contract No. YA-553-CT2-1039

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ANCHORAGE, ALASKA
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WGM INC.
MINING AND GEOLOGICAL CONSULTANTS

EXECUTIVE SUMMARY

The Bloomington GRA is located in Bear Lake County in southeastern Idaho. The GRA includes one BLM Wilderness Study Area: Worm Creek (37-77), totalling 40 acres. Bedrock in the region consists of a thick section of folded and thrust-faulted sedimentary rocks. The predominant rock types are limestone and quartzite.

There are numerous mineral occurrences in the Bloomington GRA but no known energy resource occurrences. Small lead and copper deposits are common in the region and were mined on a small scale in the early 1900s. The Paris-Bloomington phosphate district which was mined in the 1930s is located in the eastern part of the GRA. This district has substantial resources of vanadium-rich phosphate with possible by-product uranium. The area is underlain by favorable structures and source rocks for oil and gas but the nearest test wells are two shallow holes just east of the GRA.

The Worm Creek WSA is considered to have high favorability for the occurrence of hydrocarbons and vanadium-bearing phosphate. The WSA has moderate favorability for the occurrence of lead and copper.

GEM RESOURCES CLASSIFICATION
OF THE WORM CREEK WSA (37-77), IDAHO

<u>Resource</u>	<u>Classification</u>
1. Locatable Resources	
a. Metallic Minerals	3C(Pb)/ 3B(Cu)/ 4C(V)
b. Uranium-Thorium	3B
c. Non-Metallic Minerals	2C
2. Leasable Minerals	
a. Oil and Gas	4C
b. Low Temperature Geothermal	1B
High Temperature Geothermal	2B
c. Sodium and Potassium	2B
d. Other	4C
	(Phosphate)
3. Saleable Resources	2C

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BLOOMINGTON GRA, IDAHO1.0 INTRODUCTION

The Bureau of Land management has adopted a two-phase procedure for the integration of geological, energy and minerals (GEM) resources data into the suitable/non-suitable decision-making process for Wilderness Study Area (WSAs). The objective of Phase I is the evaluation of existing data, both published and available unpublished data, for interpretation of the GEM resources potential of the WSAs. Wilderness Study Areas are grouped into areas based on geologic environment and mineral resources for initial evaluation. These areas are referred to as Geology, Energy, Mineral Resource Areas (GRAs).

The delineation of the GRAs is based on three criteria: (1) a 1:250,000 scale of each GRA shall be no greater than 8½ x 11 inches; (2) a GRA boundary will not cut across a Wilderness Study Area; and (3) the geologic environment and mineral occurrences. The data for each GRA is collected, compiled, and evaluated and a report prepared for each GRA. Each WSA in the GRA is then classified according to GEM resources favorability. The classification system and report format are specified by the BLM to maintain continuity between regions.

This report is prepared for the Bureau of Land Management under contract number YA-553-CT2-1039. The contract covers GEM Region 2; Northern Rocky Mountains (Fig. 1). The Region includes 50 BLM Wilderness Study Areas

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**BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS**

***Bloomington GRA,
Idaho
Location Map***

SCALE: 1" = 45 MILES

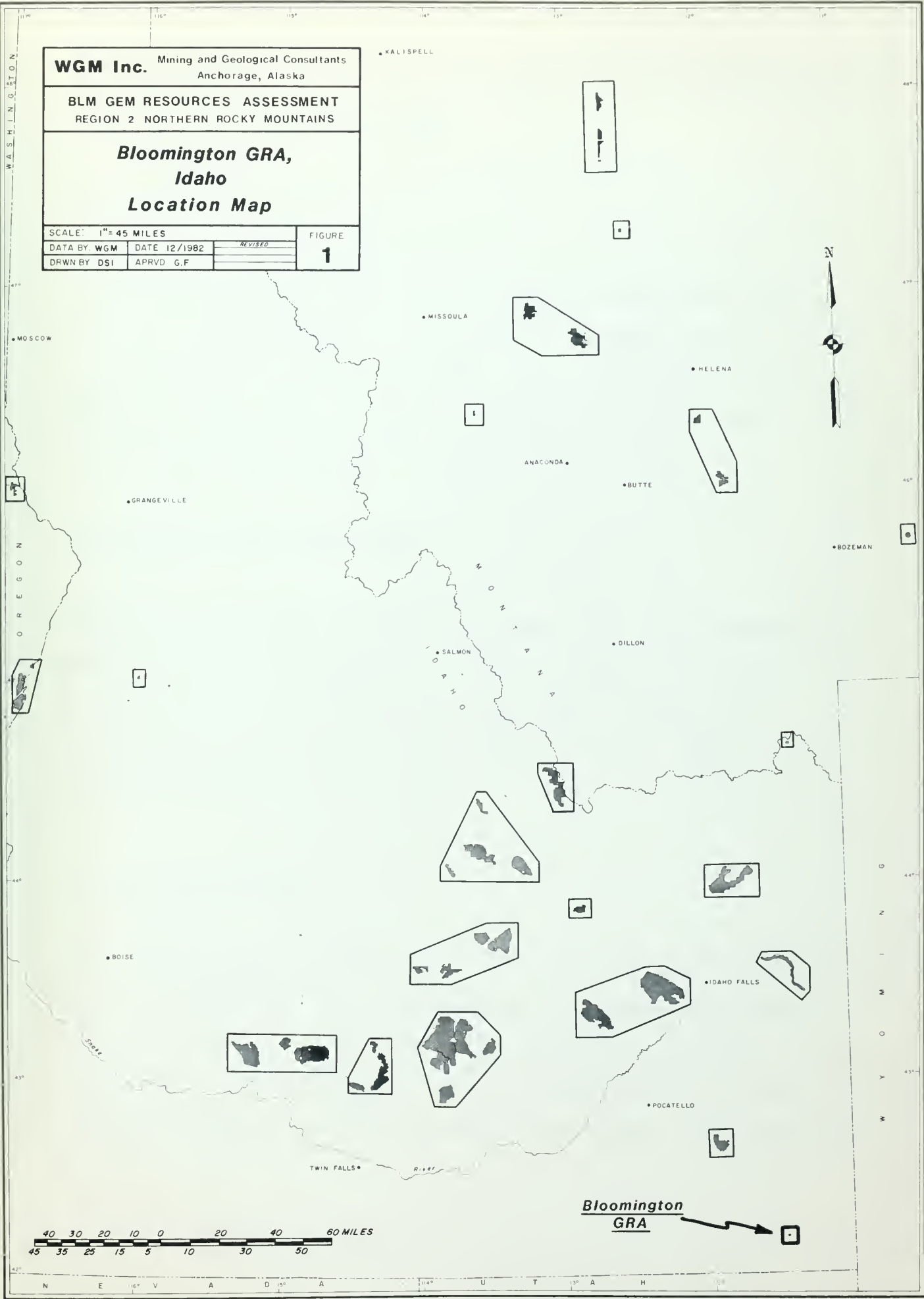
DATA BY: WGM DATE: 12/1982

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REVISED

FIGURE

1



totalling 583,182 acres. The WSAs were grouped into 22 GRAs for purposes of the Phase I GEM resources evaluation.

1.1 Location

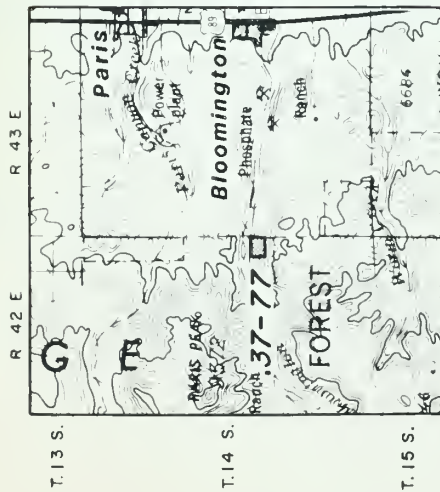
The Bloomington GRA is located in Bear Lake County, southeastern Idaho in Ts.13-15S., Rs.42-43E (Fig. 2). The towns of Bloomington and Paris are just inside the eastern boundary of the GRA. There is one Wilderness Study Area (WSA) in the GRA, Worm Creek (37-77) covering 40 acres. The area is in the Soda Springs Resource Area of the Idaho Falls BLM district.

1.2 Population and Infrastructure

Paris, with a population of 707, is the largest town in the Bloomington GRA. Montpelier (pop. 3,107), seven miles to the northeast, is the largest community in the immediate area. The area is well developed and has numerous primary and secondary roads. Access is via U.S. Highway 89 which crosses the area from north to south.

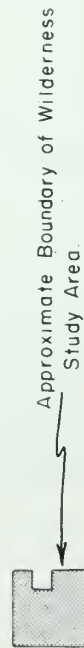
1.3 Basis of the Report

This report is based on a compilation, review and analysis of the available published and unpublished data on the geology, energy and mineral resources of the Bloomington GRA. The GRA is in the Preston NTMS Quadrangle. Only a few geologic and mineral resource studies have been done in the area but these were detailed studies which provide much useful data. BLM records of



BLM Wilderness Study Areas Included in the Bloomington GRA.

WSA	NAME	ACREAGE
37-77	Worm Creek	40



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BLM GEM RESOURCES ASSESSMENT REGION 2 NORTHERN ROCKY MOUNTAINS		Bloomington GRA, Idaho Topographic Map	
SCALE 1"=4 MILES (1:250,000)	FIGURE	DATE 9/1982	2
DATA BY WGM	APRVD G F	DRWN BY DSI	

oil and gas leases and mining claims were reviewed and records of the Idaho Oil and Gas Commission were searched.

The data were compiled and reviewed by WGM project personnel and the panel of experts to produce the resource evaluation which comprises this report. Personnel involved in the report preparation are listed below.

Greg Fernette, Senior Geologist, WGM Inc.	Project Manager
C.G. Bigelow, President, WGM Inc.	Chairman, Panel of Experts
Joel Stratman, Geologist, WGM Inc.	Project Geologist
Jami Fernette, Land and Environmental Coordinator, WGM Inc.	Claims and Lease Compilation

Panel of Experts

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R.S. Fredericksen, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
David Blackwell, Ph.D., Professor Geophysics, Southern Methodist University	Geothermal.
Jason Bressler, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
Gary Webster, Ph.D., Chairman, Department of Geology, Washington State University	Oil and gas.
William Jones, Senior Geologist, WGM Inc.	Metallic minerals, coal, industrial minerals.
J.F. McOuat, President, Watts, Griffis & McOuat Ltd.	Mineral economics, and industrial minerals.
E.F. Evoy, Senior Geologist, Watts, Griffis & McOuat Ltd.	Uranium and thorium.

1.4 Acknowledgements

We are indebted to Tim Carroll, BLM District Geologist, Idaho Falls district and Joe Rasmussen of the Minerals Management Service, Pocatello, Idaho, for their assistance during the compilation phase of this project.

2.0 GEOLOGY

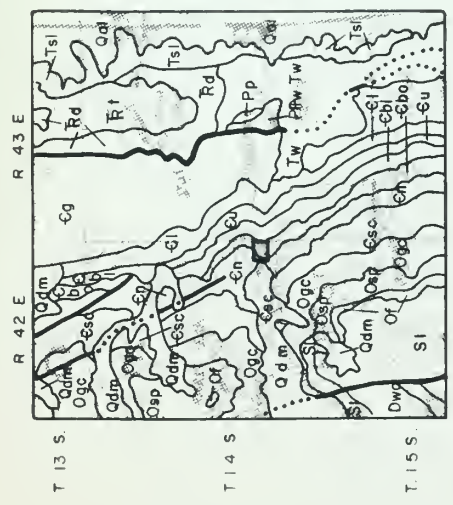
2.1 Introduction

Geologic mapping in the eastern part of the Bloomington GRA was completed by Mansfield (1927). Additional mapping including the eastern edge of the GRA was done by McKelvy and Strobell (1955). The western part of the Bloomington GRA was included in the mapping of the southeastern portion of the Preston Quadrangle (Coulter, 1956; Oriel and Platt, 1968). All of these maps were used in the 1:250,000 compilation map of the Idaho portion of the Preston Quadrangle (Mitchell and Bennett, 1979). The western three-fourths of the Bloomington GRA is underlain by Cambrian (600-500 m.y.) through Silurian (435-395 m.y.) age strata (Fig. 3). The eastern one-fourth of the area is underlain by Quaternary (2 m.y.-present) and Tertiary (65-2 m.y.) alluvial sediments which lap against Triassic (230-195 m.y.) strata.

According to Mansfield (1927) the stratigraphy of southeastern Idaho includes a maximum of 43,745 feet of miogeoclinal strata of Paleozoic (600-230 m.y.) and Mesozoic (230-65 m.y.) age. These rocks in the Bloomington GRA are dominantly marine limestones, dolostones and quartzites of the Paleozoic; marine limestones, sandstones and shales of the lower and middle Mesozoic; and interbedded marine and non-marine sandstones and mudstones with a few limestones of the upper Mesozoic (Fig. 4). Mitchell and Bennett (1979) do not provide thicknesses but include modern stratigraphic names as applied in the area. All of the stratigraphic names applied in the area are catalogued by Pattison (1977) and Olson (1977). Many of the stratigraphic

EXPLANATION

Qal	Stream alluvium	Recent	Quaternary
Qdm	Unsorted detrital deposits.		
Tsl	Salt Lake Formation	Pleistocene	Tertiary
Tw	Wasatch Formation	Pliocene	
Trt	Thaynes Formation	Eocene	
Trw	Woodside Shale		
Trd	Dinwoody Formation	Triassic	
Pp	Phosphoria Formation and associated rocks.		
PPw	Wells Formation	Permian	
Db	Beirdneou Formation		
Dh	Hyrum Dolomite	Devonian	
Dwc	Water Canyon Formation		
Sl	Laketown Dolomite	Silurian	
Of	Fish Haven Dolomite		
Osp	Swan Peak Quartzite	Ordovician	
Ogc	Garden City Limestone		
Esc	St. Charles Limestone		
En	Nounan Limestone		
Ebo	Bloomington Formation	Carboniferous	
Ebl	Blacksmith Limestone		
Eu	Ute Formation		
El	Langston Formation		
Eq	Brigham Quartzite		



Approximate Boundary of Wilderness Study Area.



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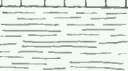
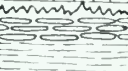
BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Bloomington GRA, Idaho
Geologic Map

SCALE 1" = 4 MILES
DATE 1/1993
DRAWN BY DSI
APPROVED G.F.

FIGURE
3

Data by: Mitchell and Bennett, 1979

A G E		UNIT NAME	Lithology	Thickness (ft.)
CENOZOIC	Pliocene	Salt Lake Formation		0 - 1000
	Eocene	Wasatch Formation		0 - 1000
MESOZOIC	LOWER TRIASSIC	Thaynes Formation		3850 - 5350
		Woodside Shale		1000 - 2000
		Dinwoody Formation		1250
PALEOZOIC	Pennsylvanian to Permian	Phosphoria Formation		235 - 805
		Wells Formation		2400
	DEVONIAN	Upper	Beirdneau Formation	850
			Hyrum Dolomite	1100 - 1600
		Lower	Water Canyon Formation	360
	SILURIAN		Laketown Dolomite	1040 - 1340
	ORDOVICIAN	Upper	Fish Haven Dolomite	450
		Mid-dle	Swan Peak Quartzite	650 - 1200
		Lower	Garden City Limestone	1000 - 1300
	CAMBRIAN	Upper	St. Charles Limestone	800 - 1800
		Middle	Nounan Limestone	675 - 1000
			Bloomington Formation	870 - 1100
			Blacksmith Limestone	750
			Ute Limestone	760
			Lanston Formation	250 - 600
		Low-er	Brigham Quartzite	1100 - 1600

Data from: Mansfield (1927),
McKelvey and Strobel (1955),
Oriell and Platt (1968).

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Bloomington GRA, Idaho
Stratigraphic Column

SCALE	DATE 3/1983	REVISED	FIGURE
DRWN BY DSI	APRVD GF		4

units have been discussed in regional summary studies of specific geologic intervals (Oaks et al., 1977; Loucks, 1977; Rose, 1977; several papers in Stewart et al., 1977; several papers in Fouch and Magathan, 1980). Peterson (1977) constructed palinspastic regional patterns for each Paleozoic period along the Rocky Mountain shelf and in the miogeocline of the Great Basin.

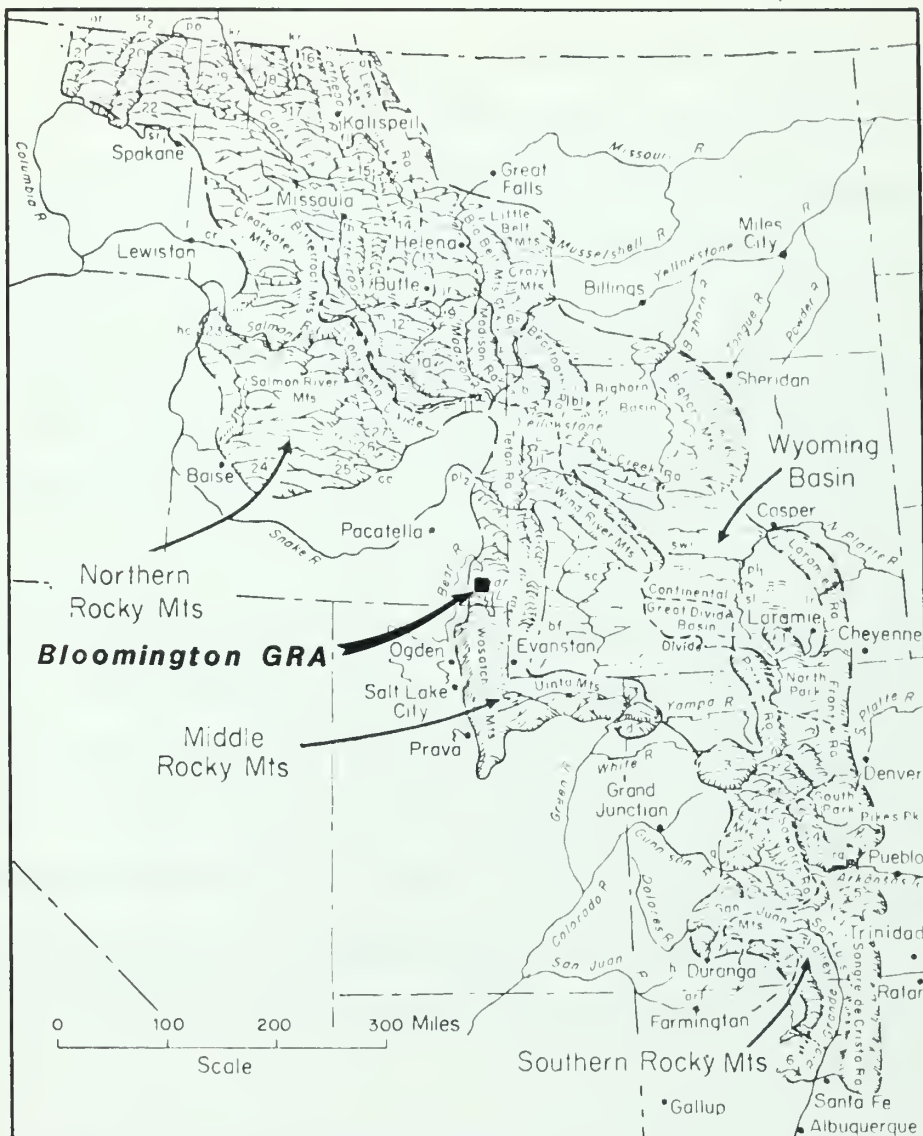
2.2 Physiography

The Bloomington GRA is located along the western boundary of the Middle Rocky Mountains sub-province of the Rocky Mountain and Wyoming Basin physiographic province (Hunt, 1974) (Fig. 5). The principal physiographic feature is Bear Lake Valley which culminates at Bear Lake, a large natural lake on the Utah-Idaho boundary. The valley averages several miles in width with an average elevation of 5,900 feet. The highest elevations are in the north-south trending Bear Lake Range. Paris Peak at an elevation of 9,372 feet is the highest topographic feature in the GRA.

Vegetation consists of saddle brush and sage in valley bottoms and aspen and conifers on mountain slopes. Minimum-maximum temperatures average 8°F in winter and 84°F in summer (Ross and Savage, 1967).

2.3 Description of Rock Units

The lithologic descriptions below are taken largely from Mansfield (1927), with additional data from Schwarze (1960), Corbett (1978), McKelvey and Strobell (1955) and Oriell and Platt (1968). The stratigraphic column is shown in Figure 4.



Data by: Hunt, (1974).

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Bloomington GRA, Idaho
Physiographic Setting

SCALE AS SHOWN		FIGURE 5
DATA BY	DATE 12/1982	
DRAWN BY DSI	APPROV G.F.	

The oldest rocks within the Bloomington GRA belong to the Brigham Quartzite of Lower (600-542 m.y.) to Middle(?) Cambrian (542-515 m.y.) age. Portions of the Brigham Quartzite elsewhere in southeastern Idaho are of latest Precambrian Z (800-600 m.y.) to Cambrian age. The Brigham consists of massive, more or less vitreous quartzite or quartzitic sandstone generally with a reddish and purplish tinge, with conglomeratic layers and some beds of hard, sandy, and more or less micaceous shale. The base of the formation is not exposed but the thickness is estimated to range from 1,000 to 1,600 feet. Few fossils occur locally in the quartzite. Trilobite trails, annelid borings and furoid are present at some localities (Mansfield, 1927).

The Langston Formation of Middle Cambrian age overlies the Brigham Quartzite. The formation is a massively bedded, bluish-gray to light gray limestone which is somewhat coarsely crystalline. It weathers to a buff color and in some locales has yellow sideritic streaks. The formation is not very fossiliferous but is known to contain Obolus ella, Bathyriscus productus, Ptychoporia, Micrometa pannula, and Zacanthorides. The thickness of the unit ranges from 250 to about 600 feet (Mansfield, 1927).

The Middle Cambrian Ute Limestone overlies the Langstone Limestone. At the base of the formation is a fine argillaceous papery shale, the Spence Shale Member approximately 30 feet thick which contains an abundant fossil assemblage. Above the shale, the Ute Limestone consists of about 200 feet of thin-bedded bluish-gray limestone succeeded by 25 feet of gray coarse-grained dolomite. Both the dolomite and limestone weather to brick-red. The remainder of the formation, approximately 505 feet, consists mainly of thin-bedded bluish-gray limestone. The upper contact of the Ute Limestone

is a locus for lead mineralization of regional extent. Locally the limestone is in part oolitic and is crowded with minute trace fossils, possibly Bryozoa. Fossils indicate a Middle Cambrian age for the Spense Shale and Ute Limestone. Fossils found in the unit include Obolus ella, Syntrophia cambria, Micromitra, Olenoides quadriceps, Alaskistrocare subcoronatum, and Zacanthoides idahoensis.

The Middle Cambrian Blacksmith Limestone is stratigraphically above the Ute Limestone. Lithologically the formation is much like the upper portion of the Ute Limestone but the bedding of the Blacksmith is more massive. The boundary between the two formations is generally marked by low cliffs. The Blacksmith Limestone consists of basal beds of cliff-forming arenaceous limestones grading upwards to thinner beds of purer limestone marked by yellow sandy beds on weathered surfaces. Fossils are scarce and poorly preserved. The age of the formation is determined by stratigraphic position with respect to the immediately underlying and overlying formations. The thickness is 750 feet (Mansfield, 1927). Numerous lead prospects occur near the formational contact between the Ute and Blacksmith Limestones.

The Middle Cambrian Bloomington Formation consists of micaceous green mudstone and claystone with some interbeds of buff and light-gray, tan- to brown-weathering, locally quartzitic siltstone and very fine-grained sandstone. Oolitic limestone and silty limestone beds are moderately abundant in the upper part while aphanitic nodular and concretionary limestone, with less oolitic limestone predominate in the lower part (Oriel and Platt, 1968). Fragments of trilobites and brachiopods are present in

some limestone beds. The formation is easily weathered (Corbett, 1978) and the thickness varies from 870 to 1,000 feet (Oriel and Platt, 1968).

The overlying Nounan Limestone consists of non-fossiliferous dark blue-gray, coarsely crystalline, medium to thinly bedded limestone, oolitic and dolomitic in part, containing yellow and reddish silty partings. This grades upward to distinctive, massive pink to pinkish-gray, finely crystalline dolomite and light to medium-gray dolomitic limestone. The thickness of the formation ranges from 675 to 1,000 feet (Corbett, 1978; Schwarze, 1960; Oriel and Platt, 1968). The Nounan Limestone and Bloomington Formation underly most of the Worm Creek WSA. Although generally unfossiliferous, a collection from the Montpelier Quadrangle yielded Ptychoparia sp. indicating a Middle Cambrian age for the Nounan (Mansfield, 1927).

The St. Charles Formation overlies the Nounan Limestone. It contains two members totalling 800 to 1,800 feet in thickness. The basalt Worm Creek Quartzite Member is a vitreous quartzite and pinkish quartzitic arkose. The upper member of the formation is mainly gray, medium-bedded dolomite with interbeds of intraformational conglomerate and chert. Fossil evidence including Billingsella coloradoensis, Lingulella desiderata, Obolus iphis, Anomocare sp., Ptychoparia sp. and Agnostus sp. indicates a Late Cambrian (515-500 m.y.) age for the St. Charles (Mansfield, 1927).

The Garden City Limestone is a medium- to thick-bedded, medium- to dark-gray limestone and dolomitic limestone. The unit contains abundant intraformational limestone pebble conglomerate and bioclastic layers in the lower

portion. Black chert bands and nodules are common, especially in the upper portion where chert may comprise 50% of the rock. The formation is highly fossiliferous where not heavily dolomitized. The thickness of the unit varies from 1,000 to 1,300 feet (Corbett, 1978; Schwarze, 1960; Oriel and Platt, 1968). The fauna of the Garden City is Early Ordovician (500-479 m.y.) or Beekmantown in age (Mansfield, 1927).

The Swan Peak Quartzite of Middle Ordovician (479-450 m.y.) age is a massive to thick-bedded, buff, tan, pink, and light gray quartzite with a basal zone of about 100 feet of feldspathic sandstone. The quartzite contains abundant fucoidal markings and weathered surfaces are commonly iron-stained. The thickness of the unit varies from 650 to 1,200 feet (Corbett, 1978; Schwarze, 1960; Oriel and Platt, 1968). The age assignment is based on faunal evidence (Mansfield, 1927).

The Upper Ordovician (450-435 m.y.) Fish Haven Dolomite is a fine- to very finely-crystalline dolomite. The upper part is thin- to medium-bedded with alternating gray and lighter or mottled gray coarsely crystalline dolomite with some brachiopod and coral fossils. The middle to lower portion contains abundant coral and brachiopod fossils and is a massive dolomite with black chert. The total thickness of the formation is 450 feet (Corbett, 1978; Schwarze, 1960; Oriel and Platt, 1968).

The succeeding Laketown Dolomite is a finely-crystalline dolomite consisting of a lower light gray, thin- to medium-bedded dolomite which grades upward into very light gray a medium-bedded to massive dolomite. The lower contact with the Fish Haven Dolomite appears conformable and gradational. It

contains recrystallized unidentifiable ghosts of fossils and some poorly preserved brachiopods (Corbett, 1978; Swartze, 1960; Oriel and Platt, 1968). The fauna of the Laketown is at least in part Middle Silurian (430-410 m.y.) or Niagaran (Mansfield, 1927). The thickness of the unit is 1,040 to 1,340 feet (Oriel and Platt, 1968).

The Water Canyon Formation of Lower Devonian (395-370 m.y.) age can be divided into two parts. The lower part consists of light-gray, medium- to thin-bedded, very fine-grained silty dolomite that weathers grayish-pink and orange-pink. The upper part of the formation is medium-bedded, medium-grained, light-brown, cross-bedded sandstone. The total thickness of the formation is 360 feet (Oriel and Platt, 1968).

The Hyrum Dolomite of Middle (370-360 m.y.) and Upper Devonian (360-345 m.y.) age is made up of thin- to medium-bedded, finely laminated, dark-blue-gray weathering dull brown, finely to very finely crystalline, petroliferous smelling dolomite. It contains numerous beds of light-gray, thin- to thick-bedded dolomite and some thin beds of gray subaphanitic limestone. The thickness of the unit ranges from 1,100 to 1,650 feet (Oriel and Platt, 1968).

The Beirdneau Formation of Upper Devonian age consists of carbonate rocks which can be divided into an upper and lower unit. The lower part is made up of gray, tan and pink, thin- to medium-bedded silty limestone, sandy limestone, calcareous quartz siltstone, and calcareous quartz sandstone. The upper part consists of thinly interbedded, finely laminated, light to dark gray calcitic dolomite and dolomitic limestone. Present within the

upper unit of the Beirdneau is the "contact ledge limestone" of Williams (1948), a medium to massive gray aphanitic to finely crystalline cliff-forming limestone containing some bioclastic layers. The thickness of the formation is 850 feet (Oriel and Platt, 1968).

The Wells Formation unconformably overlies the Beirdneau Formation. The Wells can be roughly divided into three units totalling 2,400 feet in thickness: (1) a lower 100 to 750 feet thick section of fossiliferous sandy and cherty limestones with interbedded sandstones, and dark gray to bluish-gray limestones containing concentrically banded oval chert nodules about 6 to 8 inches in diameter, (2) a middle unit, 1,700 to 1,800 feet thick, of sandy limestone with sparse thin beds of quartzite and sandstone, and (3) an upper 75 foot or less thick unit of dense, very fine textured sandstone grading into siliceous limestone. The upper unit contains white, massive, cliff-forming beds and chert bands ranging from two inches to one foot in thickness. Silicified brachiopods are common in the chert beds. Fossils are common in the Wells Formation and include abundant brachiopods and bryozoans and common Foraminifera and fusulinids. The age of the formation as indicated by fossils ranges from Pennsylvanian (310-280 m.y.) to Permian (280-230 m.y.) (Mansfield, 1927; Skipp et al., 1979).

The Permian Phosphoria Formation unconformably overlies the Wells Formation. The Phosphoria is divided into two members: (1) the upper Rex Chert Member, and (2) a lower phosphatic shale member. The lower shale member is 75 to 180 feet thick and comprised of fossiliferous yellowish to brownish black phosphatic sandstones, dark brown to black phosphatic shales, beds of brown or black fetid limestones. Local chert beds and one to three economically

valuable beds of phosphorite are also present in the lower member. The Rex Chert Member, of 110 to 550 feet thick, consists of 50 to 75 feet of massive chert overlain by massive gray limestones with abundant Productus sp. and other fossils (McKelvey and Strobell, 1955).

The Dinwoody Formation of Lower Triassic (230-225 m.y.) age unconformably overlies the Phosphoria Formation. It is comprised of tan siltstone and gray limestone, totalling about 1,250 feet thick (McKelvey and Strobell, 1955).

Unconformably overlying the Dinwoody Formation is the Woodside Shale of Lower Triassic age. The formation consists of olive-drab platy shales, alternating with thin beds of brownish-gray limestone that are locally purplish and highly fossiliferous. The shales are siliceous, calcareous, and hard. Massive limestones near the top of the unit carry abundant fossils and include Terebratula sp. and Myalina sp. zones. The formation ranges from 1,000 to 2,000 feet in thickness (Mansfield, 1927).

Overlying the Woodside Shale is the Lower Triassic Thaynes Formation. The Thaynes consists of light gray dense limestones with interbedded gray shales and yellow sandstones overlain by yellowish sandstones which grade stratigraphically upwards into dense, massive olive-drab, siliceous limestones. Many horizons in the formation are fossiliferous. The Lower Triassic age is based upon ammonite zones which occur 1,000 to 2,250 feet above the top of the Paleozoic formations. The thickness of the Thaynes ranges from 3,850 to 5,350 feet (Mansfield, 1927).

Unconformably overlying the Thaynes Formation is the Eocene (55-38 m.y.) Wasatch Formation. This formation is comprised of red conglomerates and sandstones with boulders largely of Paleozoic quartzites and limestones, and interbeds of tan locally coarse pisolitic limestone. Animal and plant remains indicate an Eocene age. The thickness of the Wasatch varies from 0 to 1,500 feet or more (Mansfield, 1927).

The Pliocene (6-2 m.y.) Salt Lake Formation unconformably overlies the Wasatch Formation. It commonly consists of light-gray to buff conglomerates in a white calcareous matrix. The matrix has a relatively loose texture. Color distinguishes the formation from the underlying Wasatch Formation although the distinction is not always obvious. In addition to the conglomerates, there are beds of white marls, calcareous clays, sandstones, and gritstones. Some fossils, chiefly fresh water mollusks, which have been collected from the Salt Lake Formation indicate a Pliocene age. The thickness of the unit ranges from 0 to 1,000 feet or more (Mansfield, 1927).

Units not exposed in the Bloomington GRA but which may be present the subsurface include the Lower Triassic Timothy Sandstone, the Triassic (230-195 m.y.) Higham Grit, Deadman Limestone, and Wood Shale, the Jurassic (195-141 m.y.) Nugget Sandstone, Twin Creek Limestone, Preuss Sandstone, Stump Sandstone as well as the Cretaceous (141-65 m.y.) Ganett Group and Wayan Formation.

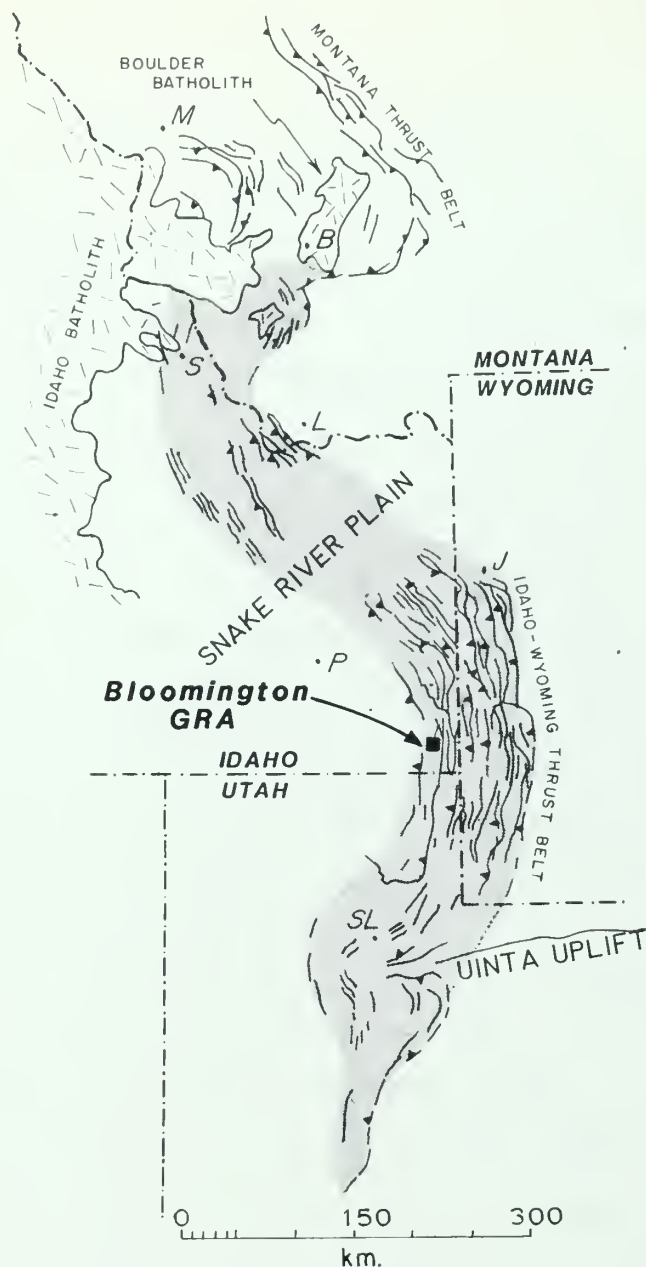
Quaternary (2 m.y. to present) deposits of stream alluvium and unsorted detrital material of Pliestocene (2-0.1 m.y.) to Holocene (0.1 m.y. to

present) age are present in major canyons and in Bear Lake Valley (Scott, 1981).

2.4 Structural Geology and Tectonics

Southeastern Idaho has been recognized by many authors as part of the Cordilleran fold-thrust belt (King, 1969; Blackstone, 1977). This province, often referred to as the "overthrust belt", includes several major thrust faults, open to overturned folds, and major block faults (Mansfield, 1927; Blackstone, 1977). The tectonic history of the "overthrust belt" was summarized by Armstrong and Oriel (1965). According to Royse et al. (1975), the age of thrusting is Late Jurassic (158-141 m.y.) to Paleocene (65-55 m.y.), whereas the block faulting is post-thrust faulting (Blackstone, 1977).

The Bloomington GRA is situated within the western portion of the Cordilleran fold-thrust belt just west of the frontal thrust belt which lies between east-central Utah and west-central Montana. The frontal thrust belt is referred to by Beutner (1977) as the Sevier orogenic belt (Fig. 6). The Sevier thrust belt is characterized by a terrane of decollement thrusting to the west. Folding is common structural feature within the Sevier belt to the east but for the most part it only affects strata that are above the decollement surfaces and does not affect the basement. The folds are most commonly asymmetric to the east although local variations do occur (Blackstone, 1977).



Structural trends in the frontal Sevier orogenic belt (stippled), Utah-Montana. Principal fold trends shown by lines; teeth on major thrust faults. M=Missoula; B=Butte; S=Salmon; L=Lima; P=Pocatello; J=Jackson; SL=Salt Lake City.

Data by: Beutner (1977)

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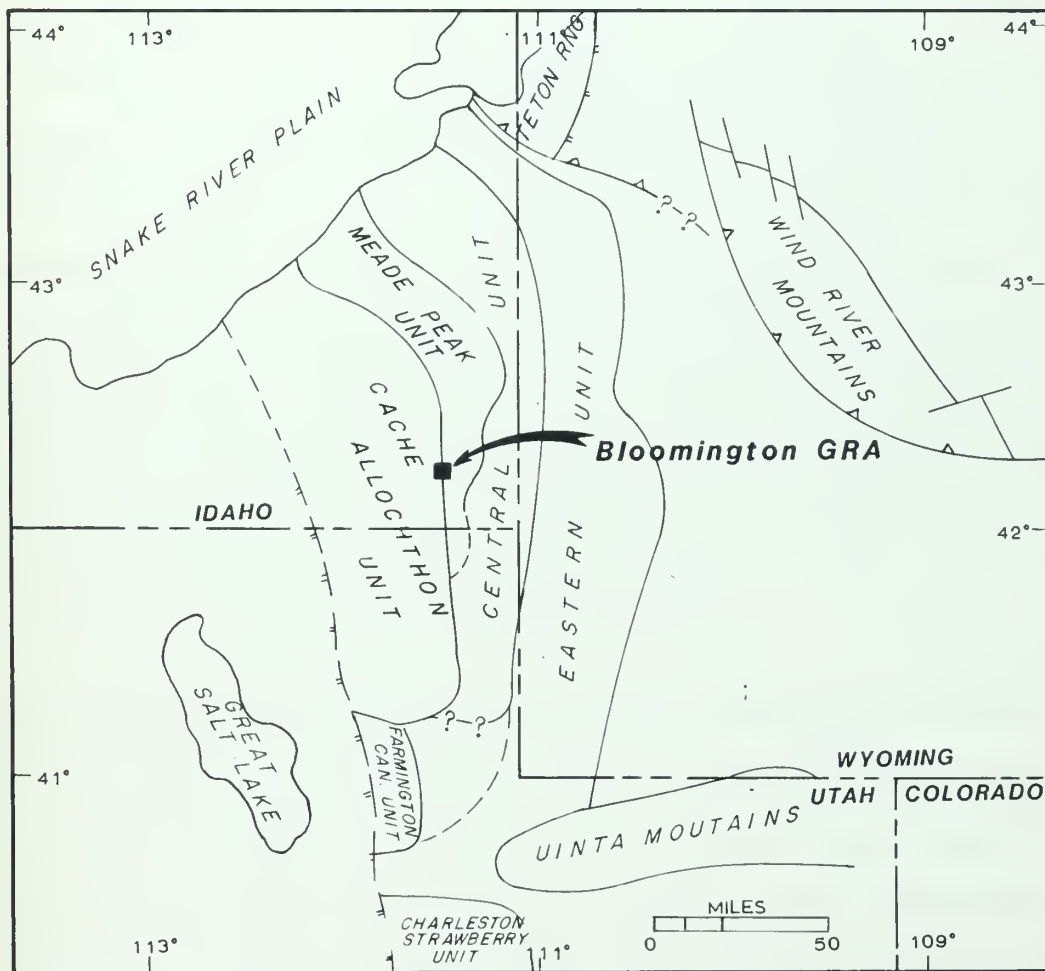
Bloomington GRA, Idaho
Regional Geologic
Setting

SCALE AS SHOWN		
DATA BY	DATE 3/1983	REVISED
DRWN BY DSI	APRVD G.F.	

FIGURE

6

Blackstone (1977) subdivides portions of the Sevier orogenic belt into several tectonic segments. The Bloomington GRA is located on the eastern edge of the Cache allochthon, and extends into the western portion of the Meade Peak unit (Fig. 7). The Cache Allochthon (Fig. 7) lies west of the trace of the Willard-Woodruff-Paris thrust fault which marks the western boundary of the Sevier orogenic belt. The allochthon probably underlies the area to the west and southwest of the Great Salt Lake and is displaced downward to the west along the Wasatch front fault. Its western extent is not exposed. The rocks in the allochthon include a thin basalt unit of phyllic schist 1.4 to 1.6 in age overlain by Precambrian Z (800-600 m.y.) Huntsville Group rocks, a thick section of Early Cambrian rocks, and a modestly thick section of early and late Paleozoic rocks ranging in age to Permian. The allochthon is broadly folded along with the underlying westward dipping thrust fault in the region east of Ogden, Utah and its eastern margin is strongly folded near Bear Lake, Utah (Blackstone, 1977). The allochthon extends northward to the vicinity of Pocatello, Idaho where it includes a thick section of Precambrian Z rocks. Its southern boundary is marked by the edge of the Farmington Canyon Complex. The Meade Peak unit occupies the region between the trace of the Meade Peak and related thrust faults on the east and the Paris thrust trace to the west. The surface rocks are largely Paleozoic with extensive outcrops of commercial grade phosphate rock (Phosphoria Formation) outlining the synclines of the region. The folds are broad and open and the trend of their axes parallels the trace of the thrust faults. Among the large folds in the Meade Peak are the Boulder Creek, Snowdrift, Dry Valley and Aspen Range anticlines which are continuous for tens of miles along strike (Blackstone, 1977).



DATA BY: BLACKSTONE, (1977)

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Bloomington GRA Regional Structural Setting			
SCALE AS SHOWN		FIGURE	
DATA BY	DATE 12/1982	REVISED	7
DRWN BY DSI	APRVD G F		

The youngest faults in the Cordilleran fold-thrust belt are high angle normal faults which displace late Cenozoic sediments of the Salt Lake Formation and equivalent age rocks (Blackstone, 1977). Royse et al. (1975) propose that the major movements of the normal faults with large displacement occurs on the listric surface concave upward which at depth merges into an older underlying west dipping thrust fault. The motion on the hanging-wall block of the normal fault is rotational. This model is adequate where a single normal fault or fault system bounds one side of a depressed segment, but the model does not provide a satisfactory explanation of structural development in a situation like that in the Gem Valley where a downthrown block is bounded on both sides by subparallel normal faults. Blackstone (1977) suggests that as Basin and Range style deformation first extended eastward, faulting followed the model proposed by Royse et al. (1975), but as the degree and magnitude of normal faulting increased, particularly along the Wasatch front fault, it extended through the allochthonous rocks in the underlying basement.

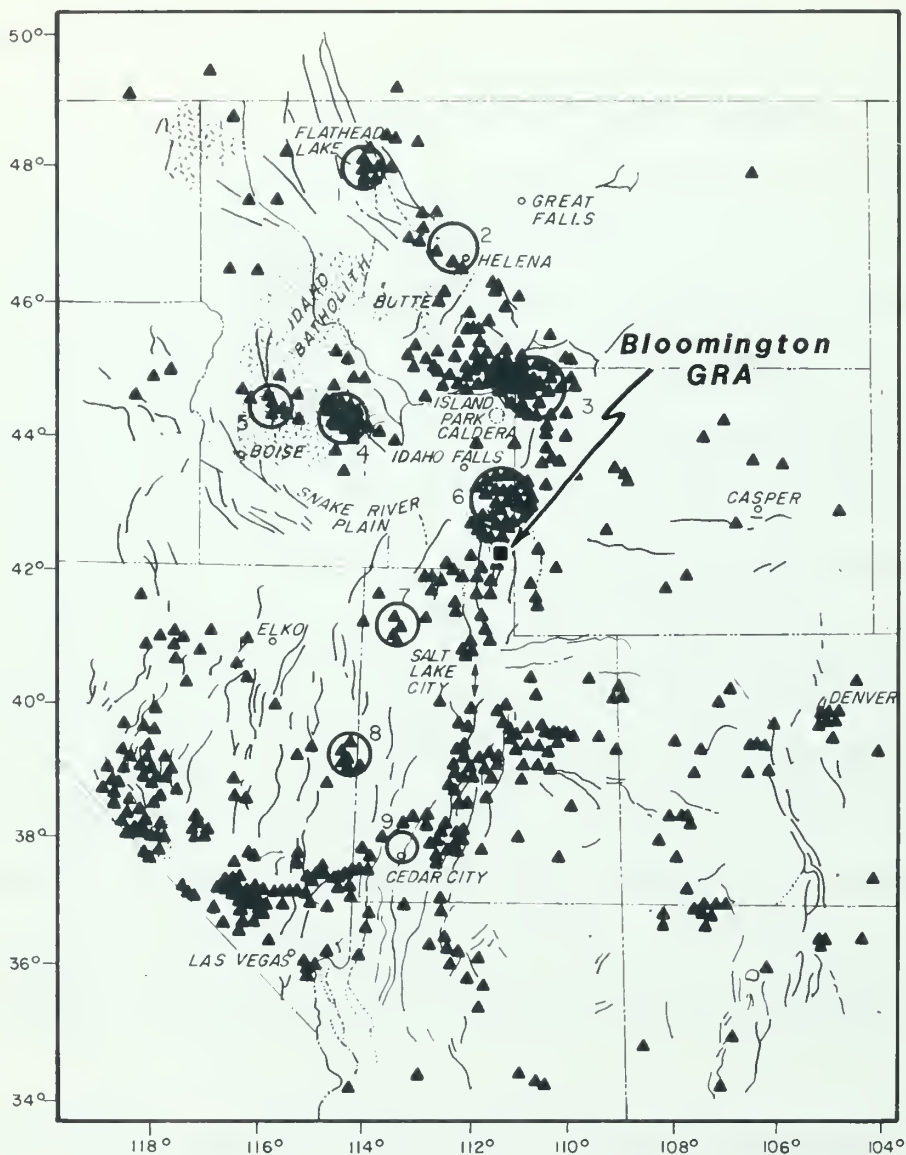
Within the Bloomington GRA several tectonic elements are present. The Bannock thrust parallels the western edge of Bear Lake Valley trending north-south. West of the thrust fault in the Bear Lake Range the strata dip shallowly westward, forming the east limb of the Bear Lake Synclinorium, and exposing a continuous section of rocks from the Cambrian Brigham Quartzite to the Silurian Laketown Dolomite. These lower Paleozoic rocks have been thrust over Permo-Triassic and younger units. East of the thrust, on the lower flanks of the Bear Lake Range, units exposed at the surface are the Wells, Phosphoria, Dinwoody and Thaynes Formations, and the Woodside Shale. The Thaynes Formation is exposed in the core of a large south plunging

anticline. Windows exposing the Phosphoria and Wells Formation occur south of the anticline. Bear Lake Valley may be a moderate to shallow graben structure.

Geologic hazards in the Bloomington GRA are related to seismic activity. The GRA lies within a seismically active area known as the Intermountain Seismic belt (Smith and Sbar, 1974), a north-trending zone of seismicity in the western United States which closely follows the boundary between the Great Basin and the Colorado Plateau-Middle Rocky Mountains provinces (Fig. 8). Seismicity is characterized by shallow focal depths and results from an east-west extensional tectonic regimen. The most significant historic seismic event in the Belt was the 1959 Hebgen Lake earthquake of magnitude 7.1.

2.5 Paleontology

Fossils are present throughout much of the section, but they are most common in the Paleozoic formations. Fossils present in each formation are tabulated by Mansfield (1927). The most noteworthy fossiliferous unit is the Spense Shale Member of the Ute Limestone. The type section for this 30-foot black shale unit is in Mill Canyon four miles north of the Bloomington GRA. The Spense Shale displays a well preserved Middle Cambrian fauna with excellent trilobite specimens which are prized by local collectors and students. The fossils in the Spense Shale have been described by Walcott (1908) and later by Resser (1939) who termed the abundant and varied early Middle Cambrian fauna from this unit the "Spense fauna".



EPICENTERS FOR INTERMOUNTAIN SEISMIC BELT SHOWING ALL EARTHQUAKES REPORTED BY NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) OF ABOUT MAGNITUDE 3.0 OR GREATER FROM 1961 THROUGH 1970. DOUBLE ARROW SHOWS ZONE OF LOW SEISMICITY. CIRCLES MARK EARTHQUAKE SWARMS: 1, FLATHEAD LAKE, MONT.; 2, HELENA, MONT.; 3, YELLOWSTONE PARK; 4, SAWTOOTH RANGE, IDAHO; 5, IDAHO BATHOLITH; 6, CARIBOU RANGE, IDAHO; 7, GREAT SALT LAKE DESERT, UTAH; 8, LEHMAN CAVE MONUMENT, NEVADA; 9, CEDAR CITY, UTAH

DATA FROM SMITH AND SBAR (1974)

0 70 140 210 MILES
SCALE APPROXIMATE

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Bloomington GRA, Idaho
Regional Seismicity

SCALE	AS	SHOWN	FIGURE
DATA BY:	DATE	3/1983	REVISED
DRWN BY: DSI	APRVD	G F	8

2.6 Historical Geology

The depositional history of the area begins at 850 million years ago as Precambrian strata were deposited in an epicratonic trough or troughs from continental sources to the east. This was followed by formation of an extensive miogeosyncline which developed along the entire length of the cratonic margin and in which a thick sequence of sediments accumulated. Deposition was essentially continuous from late Precambrian to Early Cambrian and the miogeosyncline existed as a depositional site throughout lower Paleozoic time. In southeastern Idaho by the end of Permian time, approximately 35,000 feet of Paleozoic strata, principally carbonates had accumulated in the miogeosyncline. The Paleozoic units in the trough are generally continuous with deposits of the same age on the shelf to the east. At the hinge line of the trough near what is now the Idaho-Wyoming border, however, the pre-Tertiary strata accumulated to less than 12,000 feet primarily due to the pinchout of Early Cambrian rocks against the edge of the trough. During lower Mesozoic time the site of deposition in the miogeosynclinal trough was about the same as earlier (Blackstone, 1977).

The site of major deposition began to shift eastward during the Triassic since the thickest sections of Triassic rocks were deposited slightly east of the sites of maximum Paleozoic accumulation. Orogenic uplift associated with the Sevier orogenic event in northeast Nevada and northwestern Utah accelerated this eastward shift. The depositional pattern changed drastically by Jurassic (195-141 m.y.) time as the major site of deposition continued its eastward shift during Jurassic and Cretaceous (141-65 m.y.)

time when thick locally coarse clastics were deposited in what is now the eastern part of the Rocky Mountain Thrust Belt (Blackstone, 1977). These sediments are believed to be the source rocks for several of the oil and gas deposits within the "overthrust belt" (Powers, 1977).

The result of deposition beginning about 850 million years ago and ending in the Cretaceous was formation of a wedge-shaped prism of sediments on a basement complex 1.6 billion years old or older. The western edge of the miogeosynclinal prism was as much as 60,000 feet thick while total thickness along the hinge attained a thickness of 12,000 feet. Parameters which were to influence the localization of thrust faults during later deformation include: (1) variation within the sedimentary prism (i.e. limestone versus shale); (2) the surface of the older Precambrian basement; (3) the extent and volume of sediments; and (4) distribution of fluid pressures (Blackstone, 1977).

Deformation of the miogeosynclinal prism was initiated during the Sevier orogeny which began by latest Jurassic time (Royse et al., 1975; Beutner, 1977). The first thrust plate in the Rocky Mountain Thrust Belt of Idaho-Wyoming-Utah to be activated was the Cache Allochthon as evidenced by the deposition of thick conglomerates belonging to the Ephriam of Late Jurassic (158-141 m.y.) and Early Cretaceous (141-100 m.y.) age (Armstrong and Oriel, 1965). Deformation shifted eastward with time progressively involving the Meade Peak, Central, and Eastern units (Fig. 7) as older thrust faults "piggy-backed" on the youngest (Paleocene - 65 to 55 m.y.) thrusts (Blackstone, 1977).

Basin and range block-faulting was initiated in the mid-Tertiary and continues to the Holocene, a manifestation of an extensional tectonic regimen. Graben structures (such as Bear Lake Valley) formed deep linear basins as a result of the normal faulting. Subsequently these basins were filled with thick accumulations of Tertiary sediments (Blackstone, 1977).

By the Pliocene volcanic activity became widespread in south-central Idaho producing deposits of ash and volcanic flows. However, none of these rocks occur in the Bloomington GRA. The area continues to be one of high heat flow as indicated by the presence of thermal springs such as those located near Soda Springs.

3.0 ENERGY AND MINERAL RESOURCES

3.1 Introduction

Data on known energy and mineral deposits was compiled through a review of all available information. Principal sources are the U.S. Bureau of Mines MILS Data File, the USGS CRIB File, and publications by Mitchell et al. (1981), Mansfield (1927), McKelvey and Strobell (1955), Mitchell et al. (1980), Breckenridge (1982), Savage (1969) and Service (1966).

3.2 Known Mineral and Energy Deposits

No mineral or energy deposits are known in the Bloomington GRA. Several lead prospects, described in the following section, have past production but no data is available concerning present status or reserves.

3.3 Known Mineral and Energy Prospects, Occurrences, and Mineralized Areas

Numerous lead occurrences are present in the Bloomington GRA (Fig. 9, Table I). These are part of an extensive belt of galena showings scattered from Woodruff, Utah north to Soda Springs, Idaho. The deposits occur chiefly along the contact between the Ute Limestone and Blacksmith Limestone. This mineralized horizon extends beneath the Worm Creek WSA. The mineralization consists of galena, cerussite, and wulfenite in a gangue of calcite and dolomite. The upper contact of the Blacksmith is also locally mineralized with copper minerals. Mansfield (1927) notes that prospects along the contact are too numerous to count and the mineralized zones are traceable

LEGEND

- Mineral Orebody
- ▣ Mineral Deposit
- Mineral Occurrence
- ⊗ Active Quarry
- ⊗ Inactive Quarry
- ⊗ Active gravel or clay pit
- ⊗ Inactive gravel or clay pit

— occurrence number

□ commodity

Pb - Lead

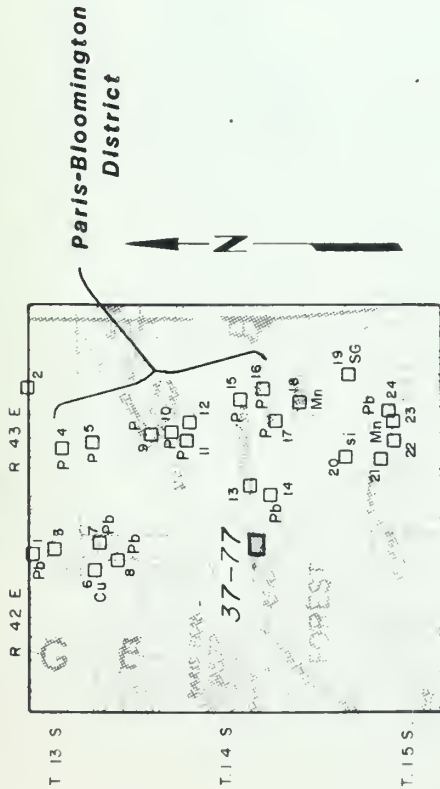
Cu - Copper

P - Phosphate

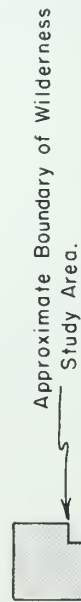
Mn - Manganese

SG - Sand and Gravel

si - Silica



Data from: Mitchell, et. al. (1981),
Mansfield (1927).



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Bloomington GRA, Idaho
Mineral Occurrences

SCALE 1"=4 MILES	FIGURE
DATE 1/1983	9
APPROVED BY DSI	APPROVED BY G.F.

TABLE I
MINERAL OCCURRENCES IN THE BLOOMINGTON GRA, IDAHO

<u>Map No.</u>	<u>Name</u>	<u>Commodity</u>	<u>References</u>
1	Boulder-Bonanza	Lead	Mansfield (1927)
2	Unnamed	Sand and Gravel	Mitchell et al. (1981)
3	Unnamed	?	Mitchell et al. (1981)
4	Unnamed	Phosphate	Mansfield (1927)
5	Bear Lake mine	Phosphate	McKelvey and Strobell (1955)
6	Humingbird group	Lead-Copper-Silver	Mansfield (1927)
7	Berrett and Ricks	Lead-Copper	Mitchell et al. (1981)
8	Boulder prospect	Lead-Silver	Mansfield (1927)
9	Unnamed	Phosphate	O'Malley et al. (1953)
10	Star mine	Phosphate	Service (1966)
11	McIlwee mine	Phosphate	McKelvey and Strobell (1955)
12	Unnamed	Phosphate(?)	Mitchell et al. (1981)
13	Unnamed	?	Mitchell et al. (1981)
14	Spense group	Lead	Mansfield (1927)
15	Paris-Bloomington	Phosphate-Vanadium	Service (1966)
16	Unnamed	?	Mitchell et al. (1981)
17	Unnamed	?	Mitchell et al. (1981)
18	Welker prospect	Manganese	Mansfield (1927)
19	Unnamed	Sand and Gravel	Mitchell et al. (1981)
20	Unnamed	Silica	Mitchell et al. (1981)
21	Unnamed	?	Mitchell et al. (1981)
22	Clark mine	?	Mitchell et al. (1981)
23	Worm Creek prospect	Manganese	Mitchell et al. (1981)
24	Sunset mine	Gold-Copper-Lead- Zinc-Silver	Mitchell et al. (1981)

for many miles. There has been no significant production from this mineral belt (Kilsgaard, 1964).

The principal mine in the belt is the Blacksmith mine, located on St. Charles Creek, 1.5 miles south of the southern boundary of the GRA. At the Blacksmith mine, reportedly having have the most extensive workings in the district (Mansfield, 1927), underground development totalled about 800 feet. In 1896 three car loads of ore averaging 80% lead and 16 car loads of concentrates averaging 78% lead were shipped from the mine. The ore consisted of crystalline aggregates of galena surrounded by dark cerussite in a gangue of siderite and limestone. Wulfenite and sphalerite occur sparingly. The ore was reported to average 27% lead, 4 oz/ton silver, and 50¢ gold (\$20/oz.). The deposit was described as tabular and trending parallel to the strike of the beds (Mansfield, 1927).

Six base metal occurrences, principally lead, are known within the Bloomington GRA and are probably part of the belt of galena showings. These occurrences are: (1) the Boulder-Bonanza, (2) the Humming bird, (3) the Berrett and Ricks, (4) the Boulder, (5) the Spense, and (6) the Sunset. The Boulder-Bonanza mine (loc. 1, Fig. 9, Table I) is located near the north boundary of the GRA. Mansfield (1927) reports that apparently 13 tons of "good percentage" ore was shipped. At the Hummingbird group (loc. 6, Fig. 9, Table I), located about 1.5 miles south-southwest of the Boulder-Bonanza mine, several hundred feet of tunnels explored copper mineralization. The mineralization is probably localized in the Blacksmith Limestone and in shales belonging to the overlying Bloomington Formation. The lodes are

about three feet thick and are continuous along the strike of the beds. Mineralization consists of brecciated quartz and jasper containing tetrahedrite-tennantite with secondary malachite and azurite. Three-hundred tons of ore were reportedly shipped from the mine in 1912 (Mansfield, 1927). At the Boulder prospect (loc. 8, Fig. 9, Table I), located about 1/2 mile southeast of the Hummingbird group, galena is present in the Ute Limestone and perhaps in the Blacksmith Limestone as well. Several hundred feet of underground workings reportedly yielded a car load of ore (Mansfield, 1927). The Berrett and Ricks prospect (loc. 7, Fig. 9, Table I) is located 1/2 mile east of the Hummingbird Group. Little is known about the Berrett and Ricks other than it is a lead-copper occurrence (Mitchell et al., 1981). The Spense group (loc. 14, Fig. 9, Table I) is located along the Ute-Blacksmith Limestone contact, in Bloomington Canyon one mile ESE of the Worm Creek WSA. Mansfield (1927) reports finding small amounts of galena in calcite on the dump. The Sunset mine (loc. 24, Fig. 9, Table I) is located in Worm Creek drainage. Little is known of this prospect other than it was reportedly developed for lead-zinc-silver-zinc-molybdenum (Mitchell et al., 1981). The occurrence is probably similar to the other galena-wulfenite-sphalerite bearing occurrences in the belt.

Two manganese prospects occur in the Bloomington GRA: (1) the Welker prospect and (2) the Worm Creek prospect (Mitchell et al., 1981; Prinz, 1964). The Worm Creek prospect (loc. 23, Fig. 9, Table I) is located on Worm Creek near the Sunset mine and the Welker prospect (loc. 18, Fig. 9, Table I) is located two miles to the north. The Welker prospect is in conglomerates belonging to the Wasatch Formation. Manganese is present as a black powdery mineral within the conglomerates (Mansfield, 1927). The Worm

Creek manganese prospect is also in the Wasatch Formation and may be similar to the Welker. A third possible manganese occurrence is reported in Paris Canyon by Mansfield (1927) but no specific data on the location is available. This occurrence is described as a network of high-grade seams and bunches of manganese ore at the contact between a conglomerate and limestone. From the description, the occurrence may be located at the contact of the Wasatch and Langston Formations near the Boulder prospect.

Six phosphate-vanadium prospects are present in the Bloomington GRA. These are part of the Paris-Bloomington district which is described by McKelvey and Strobell (1955). The prospects are in phosphatic shales belonging to the Phosphoria Formation. The phosphate zone is exposed for five miles east of the Bannock Thrust in a structure known as the Paris syncline. The phosphatic shales average 175 feet thick (Service, 1966) but no grade or tonnage estimate is available. A vanadium rich section about 10 feet thick occurs 35 feet below the Rex Chert Member of the Phosphoria (McKelvey and Strobell, 1955). Service (1966) estimates that 50 to 60 million tons of inferred reserves averaging 0.6 to 0.9% V_2O_5 are present in the district. There was small production of phosphate from the Paris-Bloomington district in the 1920s and 30s but there has been no vanadium production or recent phosphate mining (Service, 1966; Bennett et al., 1982).

One silica prospect (loc. 20, Fig. 9, Table I) is present one mile north of Worm Creek in exposures of Brigham Quartzite.

Two sand and gravel pits within the Bloomington GRA are located on exposures of the Wasatch Formation.

Seven additional prospects are shown in the Bloomington GRA by Mitchell et al. (1981) but no commodity is identified nor is any additional information available.

There are no known energy resource occurrences in the Bloomington GRA but two tests were drilled just east of the GRA (Breckenridge, 1982). These wells were slightly over 800 feet deep, and the logs of these wells (Idaho Oil and Gas Conservation Commission) contain numerous reported oil and gas shows. The sediments encountered in these tests are probably either alluvial deposits or Mesozoic sands and clays. The gas is interpreted to be leakage from older units (Wach, 1978).

3.4 Mining Claims, Leases, and Material Sites

A review of BLM claims files current to June 7, 1982 and Mineral Title plats current to August 12, 1982 shows that there are 19 unpatented and 16 patented mining claims in the Bloomington GRA (Fig. 10). The majority of the claims are in the Paris-Bloomington district. Four claims are present just south of the Worm Creek WSA but no claims are in the WSA.

A review of BLM oil and gas plats current to August 12, 1982 shows that most of the Bloomington GRA and all of WSA 37-77 is covered by oil and gas leases (Fig. 11). The lease (No. I-10497) which covers the Worm Creek WSA was issued to EPX Company of Odessa, Texas in 1977.

EXPLANATION

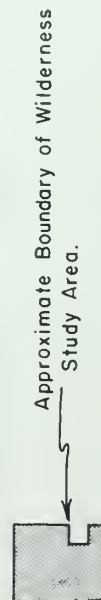
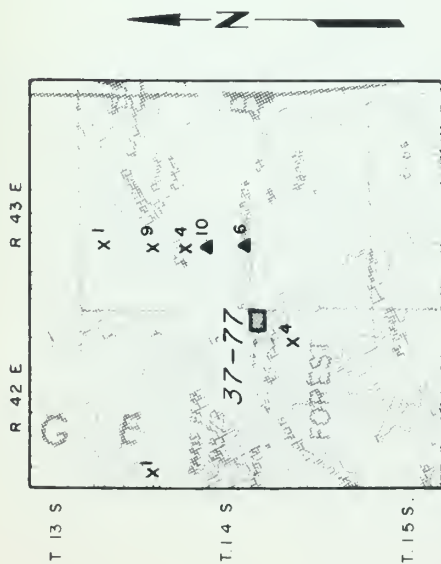
- X Unpatented Mining Claim
- ▲ Patented Mining Claim

Notes: 1) Number adjacent to symbol indicates number of mining claims in that section.

2) Area of search: Entire GRA

3) Source of Data: BLM Claims Microfiche

4) Data current to: June 7, 1982

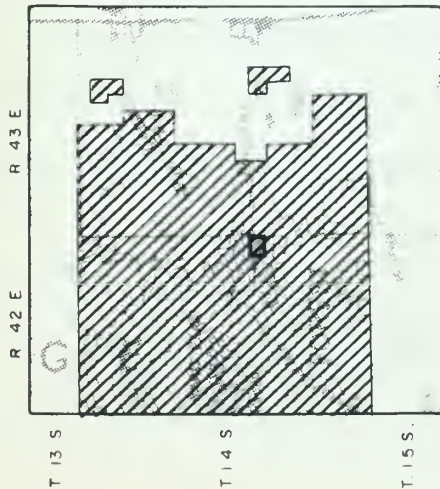


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Bloomington GRA, Idaho	
Mining Claims Density Map	
SCALE 1"=4 MILES	FIGURE 10
DATE 1/1983	REVISION
APPROVED BY DSI	APPROVED BY GF

LEGEND

-  Area covered by oil and gas leases.
-  Area covered by oil and gas lease application.

Notes: 1) Area of Search: T 15 S. R 42. 43 E
 2) Data current to: August 12, 1982
 3) Source of Data: BLM OG PLATS



Approximate Boundary of Wilderness Study Area.

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Bloomington GRA, Idaho

Oil and Gas Lease Status

SCALE	1"=4 MILES	FIGURE	11
DATA BY	WGM	DATE	1/1983
DRAWN BY	DSI	APPROV	G F

3.5 Mineral and Energy Deposit Types

Based upon the geologic environment and known mineral and energy occurrences in the Bloomington GRA there appear to be several deposit types which could be present in the area. These are: (1) carbonate-hosted lead and copper deposits, (2) phosphate deposits, (3) limestone and dolomite resources, (4) silica, (5) manganese, (6) sand and gravel, (7) oil and gas deposits, and (8) geothermal resources.

The majority of lead occurrences are localized along the contact of the Ute and Blacksmith Limestone, which is present beneath the Work Creek WSA. The simple mineralogy, essentially galena and carbonate gangue, conformably geometry, and lack of association with any igneous rocks indicate the ore to be of a syngenetic or diagenetic nature. Since only sparse data is available concerning the regional distribution and nature of the occurrences, little can be surmised concerning factors responsible for localization of the ores, such as lithofacies control, or bioherm and reefal association. The lead occurrences are strikingly similar to those of the Metaline district, Washington, where Middle Cambrian limestone and dolomite host significant deposits of zinc and lead of syngenetic to diagenetic origin (McConnel and Anderson, 1968). The southeast Idaho lead-zinc occurrences appear to be in the class of sediment-hosted deposits (Bjorlykke and Sangster, 1981; Gustafson and Williams, 1981; Sangster, 1976).

The phosphate occurrences are all in the Phosphoria Formation. The economic phosphate deposits owe their favorability as much to good access, power, water, and transportation networks as to geologic aspects. Favorable

geologic considerations are low stripping ratios, thick phosphatic shale horizons, tectonic stacking of phosphatic shale horizons, and thin chert units which impede mining. It is conceivable that in addition to the known phosphate occurrences in the Bloomington-Paris area that other more deeply buried sections are present beneath the Bannock Thrust.

Uranium could also be recovered from the Phosphoria Formation as a by-product of phosphate mining, however the concentration of uranium is too low to be mined as the primary product (Armstrong, 1964). Marine phosphates commonly contain 0.005 to 0.03% uranium which substitutes for calcium fluorapatite or crandallite (McKelvey, 1956; McKelvey and Nelson, 1950). The uranium content is generally directly related to the total phosphate content. Phosphorites composed of fish scales are generally lower in uranium than pellet phosphorites (McKelvey and Carswell, 1956). A potentially large uranium resource is present in the Phosphoria Formation in southeastern Idaho (Armstrong, 1964). The uranium content varies across the formation but averages 0.015 to 0.25 eU (Thompson, 1953). The middle portion of the formation contains the highest values; 0.018 to 0.027 eU, while the lower and upper phosphate beds contain 0.008 to 0.015 eU (Thompson, 1954). Beds of mineable thickness with over 31% phosphate usually contain 0.01 to 0.02% uranium (Thompson, 1953).

For use as high calcium limestone or high purity dolomite, limestone must contain greater than 95% CaCO_3 and dolomite must contain greater than 40% MgCO_3 (Carr and Rooney, 1975). No chemical studies evaluating the limestone and dolomite units within the Bloomington GRA are known, but Savage

(1969) sampled carbonate rocks from the Fish Haven Dolomite, Langston Limestone, Ute Limestone, and Blacksmith Limestone along St. Charles Creek two miles south of the GRA. The results of Savage's sampling show that the carbonate rocks along St. Charles Creek are of low purity (Table II). The limestone units contain sufficient magnesian minerals to appear unfavorable for production of cement (Brobst and Pratt, 1973).

TABLE II
ANALYSES OF CARBONATE ROCKS FROM ST. CHARLES CREEK AREA,
BEAR LAKE COUNTY, IDAHO¹

<u>Sample No.</u>	<u>Formation</u>	<u>CaCO₃ (%)</u>	<u>MgCO₃ (%)</u>
L53	Fish Haven	51	27
L54	Langston	71	20.4
L55	Ute	73	3.2
L56	Blacksmith	68	28.2

1. Data from Savage (1969, p. 51).

Silica, principally as quartzite, is restricted to the Brigham Quartzite (Carter and Savage, 1964). Significant exposures of the Brigham are present in the western portion of the Bloomington GRA.

Manganese occurrences within the Bloomington GRA appear to be restricted to accumulations formed by ground waters perculating through the Wasatch Formation. Unlike the setting at Lava Hot Springs, no thermal springs are present in the Bloomington area; thus hydrothermal pyrolusite deposits formed in dolomitic rocks are not likely to be present (Hewitt et al., 1963).

Sand and gravel pits are restricted to rocks within the Wasatch and Salt Lake Formations and to alluvial deposits. None of these units are present within the WSA.

Although numerous hydrocarbon leases are held throughout southeastern Idaho, no production has been discovered. As shown by Breckenridge (1982) 60 hydrocarbon tests have been drilled in the area, 30 of which penetrated depths greater than 5,000 feet. The results of some of the tests are still confidential. Shows of oil and gas have been reported in a number of the tests including two just east of the Bloomington GRA, but to date all have been plugged and abandoned. Exploration drilling continues in the area (McCaslin, 1982).

The hydrocarbon potential for southeastern Idaho was first discussed by Kirkham (1922, 1924, 1935) and Heald (1922). Kirkham suggested that both source rocks and reservoir beds along with geologic structures potentially favorable for hydrocarbon accumulation are present in southeastern Idaho. Peterson (1977) summarized the source and reservoir characteristics of rocks belonging to each geologic period from the Cambrian through the Jurassic in the eastern Great Basin and western Rocky Mountain shelf. He concluded that factors favoring hydrocarbon accumulation include: (1) the presence of dominantly marine and varied lithologic facies, (2) the presence of good to excellent potential source rock and shallow-water reservoir facies, and (3) the existence of long continuing and extensive depositional shelves and shelf-margins accompanied by subsiding marginal basins of deposition. These paleogeographic-environmental factors provide an excellent combination of factors favoring generation and early accumulation of petroleum in several

parts of the stratigraphic section, particularly the middle to late Paleozoic. This statement also applies to southeastern Idaho.

The nearest commercial production to the Bloomington GRA is from 16 fields approximately 30 to 85 miles southeast in the "overthrust belt" of northern Utah and southwestern Wyoming. This area has been developing rapidly in the past eight years (McCaslin, 1981b) and is now recognized as a major petroleum province (Powers, 1977) with at least three giant oil fields (Lamb, 1980; McCaslin, 1981a). Several of the northern Utah-southwest Wyoming fields have multiple pay horizons with at least eight producing horizons present in the Paleozoic and Mesozoic. Powers (1977) estimates that between 0.6 and 3.0 billion barrels of oil and 4.0 to 12.0 trillion cubic feet of gas will be produced from the Idaho-Wyoming-Utah thrust belt.

The Bloomington GRA is structurally and stratigraphically similar to that of the northern Utah and southwestern Wyoming thrust belt and is within the northern extension of the same structural province. Although the Nugget Sandstone, a major reservoir bed in the Utah-Wyoming area, is reported to have little reservoir potential in southeastern Idaho (Kamis, 1977), there are seven other recognized producing horizons in the Utah-Wyoming area which have potential equivalents in the Bloomington GRA. In addition, other potential reservoir beds exist in the Bloomington GRA. Other evidence supporting the possibility of hydrocarbon deposits in the Bloomington GRA include the report of hydrocarbon shows in numerous test wells in southeastern Idaho. Also the recognition of the Phosphoria as an excellent

source bed (Claypool et al., 1978; Peterson, 1980) enhances the potential for the area.

Wach (1978) concluded that major potential exists for structural and stratigraphic traps along the western part of the Bear Lake Valley including the Bloomington GRA. The evidence favoring hydrocarbon accumulation in southeastern Idaho indicates that the hydrocarbon potential in the Bloomington GRA must be considered highly favorable.

In the most recent geothermal classification of the United States (Muffler, 1979), geothermal resources were divided into six categories. These are:

1. Conduction-dominated regions
2. Igneous-related geothermal systems
- 3a. High temperature (over 150°C) hydrothermal convection systems
- b. Intermediate temperature (90-150°C) hydrothermal convection systems
4. Low temperature (less than 90°C) hydrothermal convection systems
5. Geo-pressured geothermal energy systems

For the purposes of this Wilderness Study Area assessment these classes can be reduced to two: (1) high temperature (over 150°C) hydrothermal convection systems and (2) low/intermediate temperature (40-150°C) hydrothermal convection systems. Geo-pressured geothermal energy systems do not exist in the areas discussed. Theoretically geothermal resources exist everywhere because the temperature of the earth's crust everywhere increases with depth; thus, high temperatures are reached at some depth below any given point on the earth's surface. At the present time, and in the foreseeable

future, a naturally occurring hot fluid coupled with sufficiently porous and permeable rocks to allow fluid migration are prerequisites for practical use of geothermal energy; thus, conduction-dominated and "magma-tap" geothermal systems are not included in this evaluation.

There are many exploration techniques used in the evaluation of geothermal systems. The most practical techniques, in order of cost and recommended application, are: geologic mapping; spring and well geochemical analysis for "reservoir" temperature determination (Ellis and Mahon, 1977); and temperature gradient/heat flow determination in existing wells and drill holes. Other geophysical techniques such as electrical resistivity, gravity, and seismic studies are not specific to geothermal resources and may generate anomalies which have little or no relationship to geothermal systems. However, in specific geothermal areas all of these techniques are often used in exploration. Ball et al. (1979) present a brief discussion of exploration and reservoir assessment techniques and costs.

Western Montana and southern Idaho are included in the Cordilleran fold-thrust belt of western North America. Volcanic and tectonic processes have been active in these areas within the past few million of years and there are extensive manifestations of surface of geothermal resources. However, within the Cordilleran belt there are quite significant geographic variations. Based on geographic variations, the area within GEM Region 2 is divided into six geothermal provinces:

TABLE III
GEOHERMAL PROVINCES IN GEM REGION 2

1. Montana Thrust/Foothills
2. Montana Basin and Range
3. Central Idaho Basin and Range
4. Idaho Batholith/Blue Mountains
5. Southeastern Idaho Basin and Range
6. Snake River Plains

The Bloomington GRA is within the Southeastern Idaho Basin and Range province.

The Southeastern Idaho Basin and Range geothermal province is similar in many respects to the Central Idaho Basin and Range province, particularly with respect to the geological setting. Rocks in the mountain ranges of both provinces are extensively folded and thrust-faulted Precambrian and Paleozoic sedimentary rocks. The eastern boundary of the Southeastern Idaho Basin and Range province is the Wyoming Thrust Belt and/or the Wyoming Basin, but the eastern thermal boundary is poorly determined. The Intermountain Seismic belt transects the province and there are numerous micro (and larger) earthquakes in the area (Fig. 8). The hydrology is complicated because of the abundance of carbonate bedrock. In contrast to the Central Idaho Basin and Range province, there are several exposures of young volcanic rocks in the Southeastern Idaho Basin and Range province. For example, there is an extensive area of very young; less than 100,000 years old, (Mitchell et al., 1980) silicic and basaltic volcanic rocks near the Blackfoot Reservoir in the central part of this province. The Southeastern Idaho basin and Range province is continuous with the much more extensive

Basin and Range province of Utah and Nevada. Heat flows values are possibly higher in the Southeastern Idaho basin and Range province than in the Montana or Central Idaho Basin and Range provinces and may range from 75 to 100 mWm^{-2} . A number of deep hydrocarbon tests have been drilled in this province and very high temperatures have been reported from depths 2 to $2\frac{1}{2}$ miles. Geochemical data also suggest very high "base" temperatures for some of the resources in this area (Mitchell et al., 1980). However, the presence of these high temperature geothermal systems has yet to be demonstrated by deep drilling. The exception, of course, is the Raft River system where experimental exploitation for electrical and other uses of 150°C water is in progress.

There are no heat flow/geothermal gradient data available for the Southeastern Idaho Basin and Range province although there is some evidence from deep wells for high temperatures (Mitchell et al., 1980). There are no hot springs within the Bloomington GRA although Bear Lake Hot Springs occurs about 10 miles to the southeast (surface temperature 48°C , aquifer temperature 54°C) and there are extensive travertine deposits about 12 miles north of the GRA along the east side of the Wasatch Range. These deposits may be related to formerly active or currently sealed hot or warm spring circulation (Mitchell et al., 1980) related to the carbonate rocks common within Thrust belt. Mitchell (1976) has discussed the geothermal potential of Cache Valley, immediately to the west, where geochemistry indicates that temperatures as high as 150°C are present. Also the waters are higher in total dissolved solids (12-13,000 mgm/l) than most Idaho geothermal fluids.

3.6 Mineral and Energy Economics

Total Idaho lead production in 1981 was 40,300 tons, largely from the Coeur d'Alene district (Bennett et al., 1982). U.S. lead consumption in 1981 totalled 1.1 million tons of which 110,000 tons was imported (Wright, 1982). The lead industry has been affected by the world-wide recession which has resulted in low lead prices. Although it is expected that in 1982 lead supply will exceed demand by about 53,000 tons (Wright, 1982) government efforts to reduce U.S. reliance on imported lead could make domestic production more attractive.

Idaho produced approximately 5.5 million tons of phosphate rock in 1981 amounting to about 12% of U.S. production (Bennett et al., 1982). Prices rose in 1981 but consumption dropped resulting in an oversupply (Beck, 1982). Continued local governmental problems in Florida and the availability of cheap hydroelectric power are making western phosphate production more viable (Beck, 1982). J.R. Simplot Company plans to open a new phosphate mine south of Soda Springs which indicates that phosphate mining in southeastern Idaho is currently economically viable (Bennett et al., 1982).

Vanadium is produced as a by-product of phosphate production by Kerr-McGee Corporation at a plant near Soda Springs (Bennett et al., 1982). About 15% of U.S. vanadium requirements is produced as a by-product of phosphate production (McMillen, 1982). Vanadium prices have been stable in recent years, but demand is tied to steel production and has been affected by the recession (McMillen, 1982).

Government emphasis on decreasing U.S. reliance on imported oil, the recent deregulation of natural gas prices, and the overall rise in energy prices are responsible for the continued high level of exploration for oil and gas in the "overthrust belt" (McCaslin, 1982). Even small oil and gas fields, particularly in areas of well developed infrastructure such as the Bloomington GRA, are economically significant.

Based on present requirements for use of hot fluids in electrical generating techniques, geothermal systems with temperatures of less than 150°C do not have significant potential for electrical exploitation. These systems, however, can have a significant potential for low and intermediate temperature geothermal utilization for space heating, material processing, etc. if their minimum temperature exceeds 40°C. At the lower end of the spectrum, as the energy content of the resource becomes less, or the drilling depth necessary for exploitation becomes greater, there is a very ill-defined cutoff. For example, shallow ground water temperatures on the order of 10-20°C can be used for heat pump applications, and in some cases these are considered geothermal resources. However, for the purpose of this evaluation, a lower temperature than approximately 40°C is considered an economic cutoff for a geothermal resource. Another important economic factor affecting the viability of a geothermal resource is the distance from the source to the point of consumption. At lower temperatures it is not feasible to consider long-distance transportation of geothermal energy whereas for electrical grade resources long transportation distances are of course feasible. The presence of developments within and adjacent to the Bloomington GRA would ensure that geothermal resources, even low temperature ones, would be exploited.

4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

4.1 Explanation of Classification Scheme

In the following section the land in the Worm Creek WSA is classified for geology, energy and mineral (GEM) resources potential. The classification scheme used is shown in Table IV. Use of this scheme is specified in the contract under which WGM prepared this report.

The evaluation of resource potential and integration into the BLM classification scheme has been done using a combination of simple subjective and complex subjective approaches (Singer and Mosier, 1981) to regional resource assessment. The simple subjective approach involves the evaluation of resources based on the experience and knowledge of the individuals conducting the evaluations. The complex subjective method involves use of rules, i.e. geologic inference, based on expert opinion concerning the nature and importance geologic relationships associated with mineral and energy deposits (Singer and Mosier, 1981).

The GEM evaluation is the culmination of a series of tasks. The nature and order of the tasks was specified by the BLM, however they constitute the general approach by which most resource evaluations of this type are conducted. The sequence of work was: (1) data collection, (2) compilation, (3) evaluation, and (4) report preparation. No field work was done in the Worm Creek WSA.

TABLE IV
BUREAU OF LAND MANAGEMENT GEM RESOURCES LAND CLASSIFICATION SYSTEM

<u>CLASSIFICATION SCHEME</u>	<u>LEVELS OF CONFIDENCE</u>
1. The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.	A. The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.
2. The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.	B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.
3. The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.	C. The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.
4. The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.	D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

4.2 Classification of the Worm Creek (37-77) Wilderness Study Area (WSA 37-77)

4.2.1 Locatable Minerals

Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals to which are locatable under these acts include metals, ores of metals, non-metallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumicite, clay, magnesite, silica sand, etc. (Maley, 1983).

4.2.1a Metallic Minerals. WSA 37-77 (1a, Fig. 12) is classified as having moderate potential for subsurface lead mineralization near the upper contact of the Ute Limestone based on minimal direct evidence (3C). The WSA is also classified as having moderate potential for copper mineralization in the Langston Formation based on indirect evidence (3B). The WSA is classified as having high potential for subsurface vanadium resources in phosphatic shales of the Phosphoria Formation based on minimal direct evidence (4C). The basis for the classification is outlined in Sections 3.3 and 3.5.

4.2.1b Uranium and Thorium. WSA 37-77 (1b, Fig. 12) is classified as having moderate potential for subsurface low grade uranium resources in the Phosphoria Formation based on indirect evidence (3B). The basis for the classification is outlined in Section 3.5.

BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

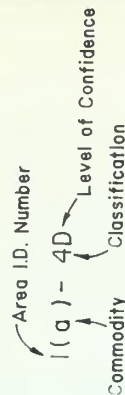
CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

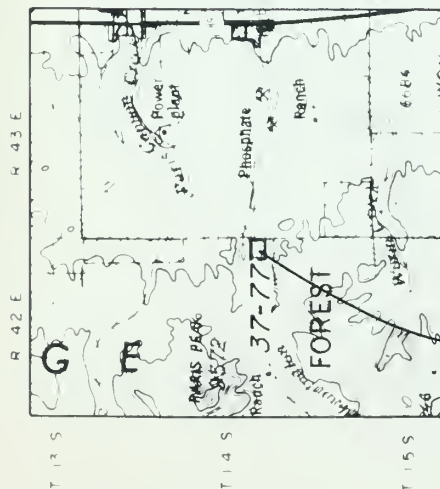
- A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.
- B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.
- C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.
- D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

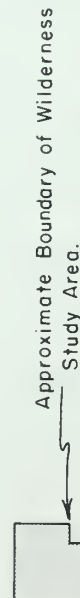


- a) Metallic Minerals
- b) Uranium and Thorium
- c) Non-Metallic Minerals

Pb - Lead
Cu - Copper
V - Vanadium



1(a) - 3C (Pb)
1(a) - 3B (Cu)
1(a) - 4C (V)
1(b) - 3B
1(c) - 2C



WGM Inc. Mining and Geological Consultants
Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Bloomington GRA, Idaho
Wilderness Study Area
Land Classification
Locatable Resources

SCALE 1" = 4 MILES (1:250,000)	FIGURE
DATE BY WGM DATE 9/1982	12
DRWN BY DSI	APRVO G.F.

4.2.1c Non-Metallic Minerals. All of WSA 37-77 (1c, Fig. 12) is classified as having low potential for locatable non-metallic minerals based on minimal direct evidence (2C).

4.2.2 Leasable Resources

Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, borates of sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

4.2.2a Oil and Gas. All of WSA 37-77 (1a, Fig. 13) is classified as having high potential for oil and gas resources based on minimal direct evidence (4C). The basis for this classification is outlined in Section 3.5.

4.2.2b Geothermal. WSA 37-77 (1b, Fig. 13) is classified as unfavorable for the occurrence low temperature geothermal resources based on indirect evidence (1B) and as having low potential for high temperature geothermal resources based on direct evidence (2B). The basis of the 1B classification for low temperature geothermal resources is by analogy with other similar areas in southeastern Idaho and the lack of known thermal manifestations in the area. The possibility of deep circulation in the carbonate units and along fault zones coupled with the evidence for high temperatures at depth

BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

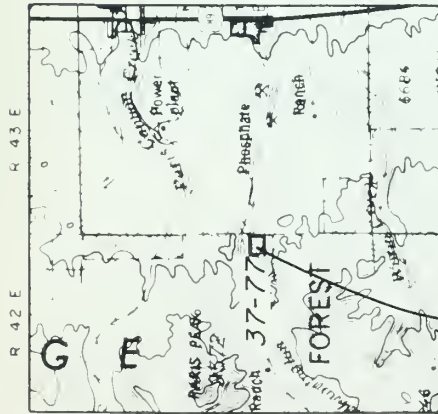
LEVELS OF CONFIDENCE

- A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.
- B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.
- C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.
- D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

Area I.D. Number
I(a) - 4D
Commodity
Level of Confidence
Classification

- a) oil and gas
- b) Geothermal: high temperature (H), Low temperature (L)
- c) Sodium and Potassium
- d) others: Asphalt (As) bitumen (bt), phosphate (ph), No specific commodity designation indicates that the rating applies to all of the above.



I(a)-4C
I(b)-1B(L)
I(b)-2B(H)
I(c)-2B
I(d)-4C(ph)

Approximate Boundary of Wilderness Study Area.



WGM Inc. Mining and Geological Consultants Anchorage, Alaska	
BLM GEM RESOURCES ASSESSMENT REGION 2 NORTHERN ROCKY MOUNTAINS	
Bloomington GRA, Idaho Wilderness Study Area Land Classification Leasable Resources	
SCALE: 1" = 4 MILES (1:250,000)	FIGURE
DATE BY: WGM DATE: 9/1982	13
DRWN BY: OSI	APRD: G.F.

elsewhere in southeastern Idaho are the basis for the 2B classification for high temperature geothermal systems.

4.2.2c Sodium and Potassium. All of WSA 37-77 (1c, Fig. 13) is classified as having low potential for sodium and potassium based on indirect evidence (2B). This classification is based on the geologic environment of the WSA and the lack of known occurrences in the region.

4.2.2d Other. WSA 37-77 (1d, Fig. 13) is classified as having high potential for subsurface phosphate resources based on minimal direct evidence (4C). The basis of the classification is outlined in Sections 3.3 and 3.5.

4.2.3 Saleable Resources

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1962. Included under this Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

The entire area of WSA 37-77 (1, Fig. 14) is classified as having low potential for saleable resources based on minimal direct evidence (2C).

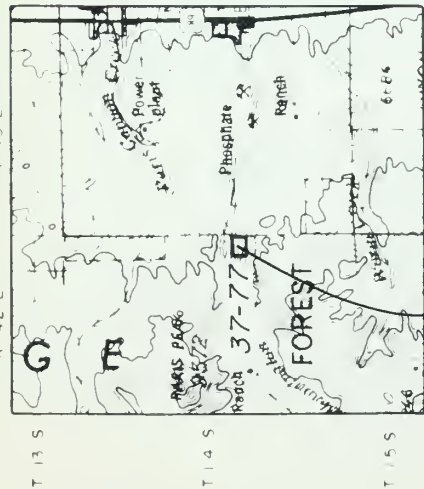
BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

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4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

- A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.
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- D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.



1-2C

Approximate Boundary of Wilderness Study Area.



EXPLANATION

Area ID. Number
1(1s)-4D
Commodity
Level of Confidence
Classification

s Sand
g Gravel
st Stone
c Cinders
p Pumice
pt Pumicite
cl Clay
Ls Limestone
dl Dolomite
P Peat
pw Petrified wood

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Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Bloomington GRA, Idaho
Wilderness Study Area
Land Classification
Salable Resources

SCALE	1" = 4 MILES	(1:250,000)	FIGURE	14
DATA BY	WGM	DATE	9/1982	
DRWN BY	DSI	APRVD	G F	

5.0 RECOMMENDATIONS FOR FURTHER WORK

The metallic mineral resource potential of the WSA could be further evaluated by detailed geologic mapping at scales of 1:10,000 and by a stream silt geochemical survey. Given the small size of the WSA only site-specific physical exploration would be of value for mineral resource assessment.

The hydrocarbon evaluation could be upgraded by completing the following studies:

1. Potential source beds other than the Phosphoria should be characterized and analyzed for thermal maturity. This investigation will indicate the types of hydrocarbons to be expected in the area and delineate those horizons where burial depths have removed any hydrocarbons present.
2. Conodont color alteration studies should be made on the Paleozoic and Triassic limestones, sands, and shales. This study will also indicate the types of hydrocarbons to be expected and horizons where burial depths have been excessive for the accumulation of oil and gas deposits.

From a practical point of view, the small size of the area prohibits exploration of any existing geothermal system unless very attractive temperatures, depths, and flow rates exist. The area encompassed by the Worm Creek WSA is so small that direct evaluation of the deep geothermal

potential is not economically feasible unless a well is drilled nearby for hydrocarbon exploration. If a nearby well is drilled temperature measurements should be made to directly evaluate the geothermal potential.

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APPENDIX I
WILDERNESS STUDY AREA MAP

A hand-drawn map of a section of the National Forest, showing a grid of 36 numbered squares. The map includes geographical features such as 'Paris Peak' (8,955 ft), 'Bloomington Peak', 'Horse Creek', 'Grandy Creek', and 'Canyon'. A road is shown running through the center, and a river is on the right. The text 'NATIONAL FOREST' is written across the middle. A scale bar at the bottom indicates '14-170'.

 WILDERNESS STUDY AREA

 AREA WITHOUT CHARACTERISTICS



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